When we are told that the genes are the chemical determinants of all the course and all the products of development, we have to remember that throughout development every cell continues to contain the same full set of genes with which the parent egg-cell was endowed. Differentiation is of the cytoplasm only, not of the nucleus: and, according to the theory, it must be due to the passage to the cytoplasm of gene-substances. We know that differentiation begins early in some embryos, later in others. Until it has advanced some way, all cells of the embryo remain in some degree totipotent, i. e., can become or generate cells of any kind. After differentiation of the cytoplasm has gone beyond a certain point in a certain direction, e. g., in direction of becoming specialized as a muscle-cell, it can generate only cells of that kind. Such at least are the rules commonly accepted. Yet in various somewhat unusual phenomena of regeneration, restitution, resolution, and reorganization, we seem to have abundant exceptions to these rules; as when a bit of specialized tissue of adult animal or plant regenerates the whole organism.

Let us try to imagine the first step of differentiation, The fertilized egg divides into two halves seemingly quite similar, but really different in that, in one of the two daughter-cells, a gene sends out into the cytoplasm some of its substance which thus acts upon it to produce an organ-forming substance *A*; while in the other cell a different gene similarly causes the production of organ-

forming substance *B.* Suppose *A* determines specialization in the direction of ectoderm, and *B* in that of endoderm. At the next cell-division, by diffusion into the cytoplasm from other genes, the one daughter-cell becomes specialized in the direction epidermis and the other in